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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/362,504	07/27/99	RAVI K	AM1126D1/T08

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PATENT COUNSEL
3050 BOWERS AVENUE
PO BOX 450A
SANTA CLARA
CA 95052

EXAMINER	
ZERVIGON,R	
ART UNIT	**PAPER NUMBER**
1763	6

DATE MAILED: 11/22/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

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Office Action Summary

Application No.	Applicant(s)
09/362,504	Kramadhati et al
Examiner	**Group Art Unit**
Rudy Zervigon	1763

☐ Responsive to communication(s) filed on _____

☐ This action is FINAL.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

☒ Claim(s) 16-36 is/are pending in the applicat

Of the above, claim(s) _____ is/are withdrawn from consideration

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 16-36 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☒ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☒ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 3

☐ Interview Summary, PTO-413

☒ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

DETAILED ACTION

Priority

1. This application appears to be a division of Application No. 08/623,445 now U.S. Patent 5,976,993, filed March 28, 1996. A later application for a distinct or independent invention, carved out of a pending application and disclosing and claiming only subject matter disclosed in an earlier or parent application is known as a divisional application or "division." The divisional application should set forth only that portion of the earlier disclosure which is germane to the invention as claimed in the divisional application.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

3. Claim 16 is rejected under 35 U.S.C. 102(a) as being anticipated by Jin Onuki et al. Jin Onuki et al have described improvements in integrated circuit step coverage and electromigration resistance of aluminum films when employing switching bias sputtering (abstract, right column, mid second, last paragraphs page 182). The switching bias sputtering described by Jin Onuki et al are embodied as "two-step bias application" (right column, last paragraph page 182). The two-step bias application is further described by Jin Onuki et al according to a method ordered according to "a

deep d.c. bias of -200V, and, second, a shallow d.c. bias of 50V for 10s" (section 2.1 - Film Formation). The method of the Jin Onuki et al process is embodied in repetitive cycles as shown in Figure 1(b). Implicit in the cyclic application of the two-step switching bias sputtering method described by Jin Onuki et al and, according to the step waveforms shown in Figure 1(b), is an unbiased time frame, in each cycle, prior to the application of the first "deep d.c. bias of -200V". It is entrusted that the establishment of a gas in a plasma state necessarily requires "flowing a process gas into a substrate processing chamber" and "forming a plasma from said process gas". Attributes which Jin Onuki et al implicitly establish.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 17,18,25-28,32-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (U.S. Pat. 5,710,486) in view of Jin Onuki et al, Boys et al (U.S.Pat. 4,500,408), Ramarotafika et al.

Ye et al (U.S. Pat. 5,710,486):

The contents of the Ye et al patent, because it is provided as an IDS reference, should be familiar to the applicant. However, a correspondence between the elements of claim 17 and the content of the Ye et al patent is provided for clarity. Accordingly, Ye et al describe a substrate processing system comprising:

i. A housing for forming a vacuum chamber (items 52/54, Figure 3, column 3, lines 49-51)

ii. A vacuum pump for forming evacuating the vacuum chamber (implied)

iii. A pedestal (item 60, Figure 3, column 3, lines 52-53), located within the housing for forming a vacuum chamber (items 52/54, Figure 3, column 3, lines 49-51), configured to hold a substrate (item 61, Figure 3, column 3, line 52-53)

iv. A gas distribution system fluidly coupled to the vacuum chamber (column 3, lines 12-16)

v. A plasma generation system (column 3, lines 62-67) for forming a plasma from a process gas within housing for forming a vacuum chamber (items 52/54, Figure 3, column 3, lines 49-51)

vi. Selective biasing of the generated plasma towards the processing substrate is provided according to the independently powered capacitive electrode (item 60, Figure 5) that supports the substrate (Figure 5; column 3, lines 49-67)

vii. A controller (implied according to column 2, lines 56-59) for controlling plasma generation means

Ye et al do not explicitly discuss a controller (implied according to column 2, lines 56-59) for controlling a vacuum pump and a gas distribution system. And so Ye et al would be modified by adding a controller.

Jin Onuki et al:

Jin Onuki et al have, as described above, introduce improvements in integrated circuit step coverage and electromigration resistance of aluminum films when employing switching bias sputtering (abstract, right column, mid second, last paragraphs page 182). The switching bias sputtering described by Jin Onuki et al are embodied as "two-step bias application" (right column, last paragraph page 182). The two-step bias application is further described by Jin Onuki et al according to a method ordered according to "a deep d.c. bias of -200V, and, second, a shallow d.c. bias of 50V for 10s" (section 2.1 - Film Formation). The method of the Jin Onuki et al process is embodied in repetitive cycles as shown in Figure 1(b). Implicit in the cyclic application of the two-step switching bias sputtering method described by Jin Onuki et al and, according to the step waveforms shown in Figure 1(b), is an unbiased time frame, in each cycle, prior to the application of the first "deep d.c. bias of -200V". Thus the Jin Onuki et al reference describe a method of deposition wherein there is selective electrode biasing to deposit a first layer without biasing the generated plasma towards the substrate, and subsequent second layer deposition under biased conditions: "a deep d.c. bias of -200V, and, second, a shallow d.c. bias of 50V for 10s" (section 2.1 - Film Formation). As discussed above, implicit in the cyclic application of the two-step switching bias sputtering method described by Jin Onuki et al and, according to the step waveforms shown in Figure 1(b), is an unbiased time frame, in each cycle, prior to the application of the first "deep d.c. bias of -200V". Successive cycles, as shown in Figure 1(b), provide additional deposited layers. The above references do not explicitly

detail the full scope of the claim 17 limitations. Specifically,Ye et al and Jin Onuki et al do not explicitly describe programmable memory controller for controlling the process vacuum pump, gas distribution system.

Boys et al (U.S.Pat. 4,500,408):

Boys et al does describe, as is discussed below, a programmable memory controller for controlling the process vacuum pump, gas distribution system, and plasma generation means.

Boys et al describe a magnetron sputter coating apparatus controlled in response to measurements of plasma parameters to control deposition parameters (abstract). Specifically, ~~according to DETD(11),~~ the current supplied by source 25 to coil 21, and the voltage, as well as current supplied by DC source 37 to target cathode 15 and anode 16. Source 25 includes a current transformer (not shown) for supplying lead 44 with a DC signal proportional to the current supplied by the source to coil 21. DC plasma power source 37 includes a current transformer (not shown) for supplying to lead 46 a DC signal proportional to the current supplied by source 37 between electrodes 15 and 16. *Pressure gauge 47* supplies lead 52 with a DC signal *having a magnitude proportional to the vacuum pressure in volume 13*. Flow meter 34 supplies a DC signal to lead 35 indicative of the flow rate of working gas flowing from pressurized gas source 31 to processing volume 13. In addition, ~~according to DETD(9),~~ DC power sources 25 and 37 are supplied from a primary, *AC power source connected to terminal 38*. Generally, power source 25 derives a variable current that is supplied to

coil 21, allowing compensation for changes in coil resistance due to temperature changes. Source 37 is controlled so that *variable* current and voltage can subsist between target cathode *second RF cathode electrode* 15 and a *first substrate holder that positions the substrate in the reaction zone while supporting the substrate atop a first RF anode electrode* 16. DC sources 25 and 37 are utilized for targets *second RF cathode electrode 15* made of magnetic or non-magnetic electrically conductive material. If, however, target *second RF cathode electrode 15* is made of a dielectric material, source 37 is an RF source, while source 25 remains a DC source. In addition, according to ~~DETD(13)~~, CPU *computer* 57 includes a conventional memory for storing a program and predetermined data for controlling the operation of sources 25 and 37, as well as orifice 32. CPU 57 is responsive to signals indicative of the desired voltage to be applied by source 37 between electrodes *second RF cathode electrode 15* and 16 and for the current to be supplied by source 37 between electrodes *second RF cathode electrode 15* and 16, as well as a desired value for the pressure in processing volume 13. The desired values for the voltage and current of source 37 and the pressure in volume 13 can be preset by an operator to initial values, or can be derived from the operator setting a desired rate of deposition for material from target cathode *second RF cathode electrode 15* to substrate 14. The set values for the voltage and current of source 37 and the *pressure* of processing volume 13 can be changed from time to time by the operator. The programmed values for the voltage and current of source 37 and the *pressure* in volume 13 are stored in the memory of CPU 57. Additionally, vacuum pump control is discussed according to adding another "variable pumping orifice" (column 8, lines 8-13; column 7, lines 38-40).

Ramarotafika et al:

Ramarotafika et al precisely describe the influence of d.c. bias (including unbiased states) of WTi films (section 3).

With the Ye et al apparatus as a footing, one of ordinary skill in the art at the time the invention was made would consider the control systems as described by Boys et al to be an obvious extension, and, thus, would have been obvious, to the Ye et al apparatus consistent with a deposition method as promoted by Jin Onuki et al and Ramarotafika et al, both discussed above. Motivation for combining the above references follows from the desire to control plasma process attributes as discussed by the Boys et al (column 3, lines 25-67) with a deposition method of Jin Onuki et al supporting sufficient motivation (abstract, right column, mid second, last paragraphs page 182).

6. Claims 19-24,29-31,35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (U.S. Pat. 5,710,486) in view of Jin Onuki et al, Boys et al (U.S.Pat. 4,500,408), Ramarotafika et al, as applied to claims 17,18,25-28,32-34 above, and further in view of Matsuura (U.S.Pat. 5,319,247). Matsuura describes a method of forming silicon and oxygen combined thin films for "superior crack resistance and insulation" (silicate, column 6, lines 4-11) by optionally (embodiment) applying silane and oxygen gases (column 7, line 67; claim 1). Operating conditions of pressure:

1mTorr≤100mT≤10Torr (column 6, line 33) and temperature: 100°C≤350°C≤450°C≤500°C (column 6, line 38) are specifically met by Matsuura.

Modifications of the Ye et al apparatus meeting the depenent claims 19-24,29-31,35 was made in the independent claims 20 and 23 for which these rejected depenent claims 19-24,29-31,35 depend. Specifically (from paragraph 5, abovel):

Ye et al do not explicitly discuss a controller (implied according to column 2, lines 56-59) for controlling a vacuum pump and a gas distribution system. And so Ye et al would be modified by adding a controller.

With the Ye et al apparatus as a footing, one of ordinary skill in the art at the time the invention was made would consider use of the Matsuura method of forming silicon and oxygen combined thin films for "superior crack resistance and insulation" (silicate, column 6, lines 4-11) by optionally (embodiment) applying silane and oxygen gases (column 7, line 67; claim 1). Motivation for combining the above references follows from the Matsuura identified improved substrate rigidity, or reducing mechanical stress, and electrical isolation as for "superior crack resistance and insulation" (silicate, column 6, lines 4-11).

Claim Rejections - 35 USC § 112

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> **The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.**

8. Claims 17, 28, and 32 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. An examiner's amendment was withheld becuase of relevent art applied in this office action. The telephone interview with Joshua D. Isenburg on November 9, 1999 is recorded in the event of allowance. Motivation for the examiner's 35 U.S.C. 112 second paragraph rejection was to resolve lack of antecedence in the claim language:

viii. Claim 17, lines 22-23,"said inductively coupled plasma"

ix. Claim 28, line 2, cancel "said second electrode"

x. Claim 32, line 13, cancel "said inductively coupled plasma"

9. Claims 17, 28, and 32 recite limitations, detailed above. There is insufficient antecedent basis for these limitations in the claim.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S,Patents: 4,885,074; 4,887,005; 5,597,438; 5,795,452

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official AF fax phone number for the 1763 art unit is (703) 305-3599. Any Inquiry of a general

nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661. If the examiner can not be reached and specific inquiry on the merits of the cases's prosecution is desired then contact the examiner's supervisor Marian Knode at (703) 308-4311.

THI DANG
PRIMARY EXAMINER
GROUP 1100